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DESIGN OF AN OPTICAL INSERT TYPE 3R1

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ABSTRACT

The goal of this research project is to design and develop a preprototype model of an optical insert that can be used as a vision corrective device when worn within the following:

CBR Protective Masks

1. M14A2 Tank Protective
2. M17 Military Protective
3. M24 Aircrewman's Protective

INTRODUCTION

Optical Insert - Type 1 (fig 1)

In 1959 this laboratory was directed by the Office of the Surgeon General to develop an optical insert that would be compatible with the E13R2 Military CBR Protective Mask (now type classified M17).

The design of the insert for the M17 mask was comprised of snap-in frames that fitted snugly into the inside perimeter of the mask eye lenses, attached to these frames were housings into which the temporal struts of the binocular/spring bridge assembly could be inserted. This arrangement permits the insert to be securely held in the proper visual attitude.

Upon completion of this project, the insert was submitted to the Office of the Surgeon General and after evaluation was subsequently approved for type classification.

Currently this optical insert is being routinely fitted to military personnel that are issued this mask and have a visual acuity of less than 20/70.

Optical Insert - Type 2 (fig 2)

Shortly thereafter the Office of the Surgeon General directed this laboratory to develop optical inserts for the E56R2 Tank CBR Protective Mask and the E75R2 Aircrewman's CBR Protective Mask (now type classified as the M14 and M24 respectively).

Efforts were made to maintain a continuity of design during the development phase of an optical insert for these masks. The binocular/spring bridge assembly was retained, however, it was necessary to devise a different method to support the insert in the mask. To accomplish this "U" shaped struts were fastened to the binocular/spring bridge assembly at the temporal area.

Mask Modifications:

The mask faceblank (faceblank for both masks identical) was modified by molding rectangular blocks containing seven holes in the right and left.temporal region. Struts on the insert can then be "plugged"

into the holes in the blocks. This method provides both a means of supporting the insert and also permits a complete range of horizontal alignment to be achieved.

This item has undergone extensive user testing by various agencies, such as the U. S. Army Aviation Board, Ft. Rucker, Ala., U. S. Army Arctic Test Board, Ft. Greely, Alaska, U. S. Army Armor Board, Ft. Knox, Ky., and recently the item was investigated as a possible Quadpartite standardization item.

Optical Insert - Type 3 (fig 3)

During the development of the Type 2 insert for the M14/M24 Protective Masks polypropylene was studied as a material for fabricating the frame of an optical insert due to its ability to withstand practically unlimited flexing in thin sections. It was felt that because of this characteristic, it would fulfill the requirement that an optical insert must be capable of being folded in the mask.

Previous studies had indicated that the lens shape and size designed for the M17 insert was capable of providing adequate visual fields, therefore, this lens design was retained for incorporation into the design of the polypropylene frame.

The hinge used in the first model had a thickness of .060 and was cold-formed using dies designed to permit forming hinge sections of various thickness. Test sections of polypropylene with hinges of this thickness were laboratory cycled 100,000 times without any indication of failure.

The evaluation of hinge sections of this thickness was undertaken to determine if such a hinge would prevent reverse flexing of the insert when it was worn in the mask.

A preprototype frame incorporating the thick hinge was fabricated. Centrally located on the right and left sides of the frame were projections that contain two holes. These holes were provided for the insertion of .078 diameter nickel silver "U" shaped temples. The metal temples may be held firmly in position in the frame by strike tabs or by other means. The original model depended on the "push fit" of the temples into the plastic frame. In addition, when the temples were bent to the required angle for fitting, they

were firmly secured in the frame. The temples provided the means of supporting the insert in the M14/M24 mask (see Optical Insert-Type 2 - mask modifications).

A model was build as described and has undergone evaluation. The results of evaluation indicated that this model was satisfactory.

DESIGN OF THE OPTICAL INSERT - TYPE 3R1 (POLYALLOMER) (fig 4)

The favorable results obtained with the polypropylene insert for the M14/M24 masks led to further studies directed toward the possible modification of this insert in such a manner that it would be capable of being fitted into the M17 mask. It was felt that if this were possible it would greatly reduce procurement and subsequent stocking of optical inserts of varying designs for the different styles of CBR masks.

The basic design of the frame was maintained, but it was necessary to make the width of the bridge narrower to prevent interference with the nose cup of the M17 mask. The visual systems of the M17 faceblank and the M14/M24 faceblank differ greatly (M17 two eyelenses - M14/M24 single facepiece eyelens), and it became necessary to allow for this difference by increasing the length of the metal temples by 3/8".

The utilization of this design of insert will require minor mask faceblank modification such as those that were accomplished in order to support the Type 2 insert in the M14/M24 mask. The modifications necessary will be the molding of rectangular protrusions containing seven holes on the inside of the mask faceblank. The protrusions will be located on the left and right sides of the mask in the temporal region and will be oriented so that the insert would be in the proper relationship to the pupils of the eyes.

For development purposes rubber blocks with seven holes were cemented to the mask. The seven holes permitted horizontal alignment 6mm above and 6mm below a central position in 3mm increments. This mock-up was presented to the U. S. Army Chemical Research and Development Laboratories, Edgewood, Md., for comments. The feeling of this group was that such a mask modification was possible and practical, however, no final decisions could be made until this laboratory provided them with samples of inserts for wearer testing.

During the course of investigation of this design of an optical insert, a new class of polymers polyallomers had become available, which exhibited the best properties of both high-density polyethylene and crystalline polypropylene. Because this material has the advantage of high-impact strength and low-temperature toughness as compared with polypropylene it was felt that the insert should be fabricated from this material. In addition to these advantages the polyallomers are superior with respect to color, clarity, moldability and resistance to blushing when bent or stretched.

The mounting of lens in this material is readily accomplished mechanically by using a small amount of heat as used in prescription laboratories. Further Standard Federal Lens Retention Tests were run on lenses mounted in Polyallomer frames in all cases they tested better then Federal Specifications, ranging form 83% to 183% above Federal Spec. Tests.

While this insert will be stocked with long temples, the fitting of this insert into the M14/24 mask is very simply accomplished. It is only necessary to cut off the temples at the marked location and bend the struts to suit the wearers facial contours.

The hinge will permit an insert made of polyallower to fold when placed in its carrier and will conform to accepted design data and will be from .010 to .015 inch thick, in order to have this hinge resist tearing in a longitudinal direction a thin web will be formed at each end of the hinge.

Vertex distance is established in the M17 and the M14/24 mask by controlling the depth that the temples are inserted into the holes in the rubber supporting protrusions in the mask.

Panoscopic tilt (reading angle) can be very easily controlled by bending the temples to the required angle (the protrusious in the mask are oriented to provide an average angle of 10^{o}) however, it would be impossible to provide a means of eleminating final adjustment of this angle due to vast differences in head sizes and facial configurations.

In order to accommodate the entire range of pupillary distances from 58mm of 70mm the insert will be made in two bridge widths, Narrow for PD from 58mm to 64mm and Wide for PD of 64mm to 70mm. Optical decentration of the lenses will be the means for establishing exact control of PD to match the wearer.

SUMMARY

An optical insert fabricated of polyallomer plastic has been designed and pre-prototype model fabricated. This insert incorporated an integral hinge that will permit it to be folded with the mask when the mask is placed in its carrier.

This insert is universally compatible with the M14, M17, and M24 CBR protective masks. (M17 mask will require minor modification-support blocks)

The insert provides vision corrective features comparible to ordinary spectacles and is capable of being adjusted for proper fit by military optical technicians.

This insert will be economical to manufacture and does not contain the many sophisticated features that are inherent in the design of the presently type-classified M17 optical insert.

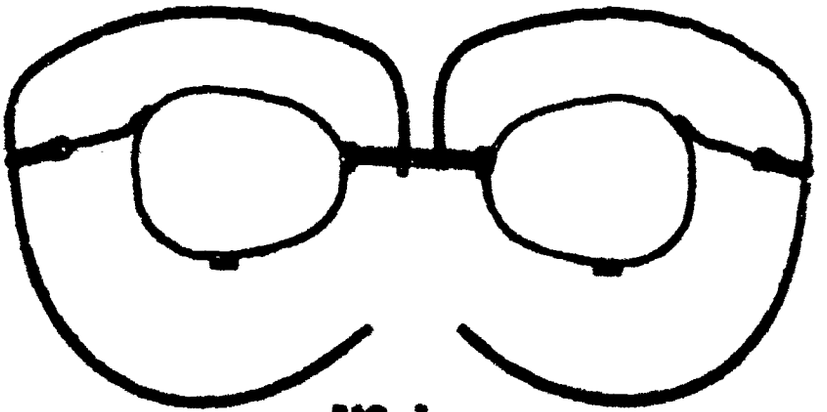

FIG. 1